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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: Fernando Gonzalez et al.	§	Group Art Unit: 2815
Serial No.: 10/751,141	§	Examiner: Nguyen, Joseph H.
Filed: December 31, 2003	§	
For: Transistor Having Vertical Junction Edge and Method of Manufacturing the Same	§	Atty. Docket: MICS:0114 02-1010

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May 22, 2006 — Robert A. Manware
Date

REPLY BRIEF PURSUANT TO 37 C.F.R. § 41.41 AND IN RESPONSE TO THE EXAMINER'S ANSWER MAILED MARCH 31, 2006

This Reply Brief is being filed pursuant to 37 C.F.R. § 41.41 in response to the Examiner's Answer mailed on March 31, 2006. Specifically, this Reply Brief addresses the Examiner's continual insufficiency and inconsistency of the Examiner's rejections based on the Michejda reference. Appellants respectfully ask that the Board carefully consider not only the points made in this Reply Brief, but also Appellants' complete argument set forth in the previously filed Appeal Brief (submitted to the Office on January 13, 2006).

Independent claims 12, 17 and 22 each recite, *inter alia*, a transistor comprising "a drain terminal comprising a doped polysilicon material *disposed within a first shallow cavity formed in an isolation oxide region*" and "a source terminal comprising a polysilicon material *disposed within a second shallow cavity formed in the isolation oxide region*." Emphasis added.

One exemplary embodiment of the recited structure is illustrated in Figs. 3-6, which are fully described by the accompanying text in the present application. Specifically, in accordance with one exemplary embodiment, isolation oxide 58 is disposed within *trenches 52*, as illustrated in Fig. 3. Subsequently, *shallow cavities 60* are formed in the isolation oxide 58. A conductive material 64, such as polysilicon, is disposed within the cavities 60, as illustrated in Fig. 5. Finally, the structures are etched to form the source terminal 36 and the drain terminal 38 disposed within the shallow cavities 64 formed in the isolation oxide 58. As noted in the present application, the term "cavity" is often used interchangeably with the word "trench" in that they are similar structures. However, "cavity" is used in the present application to distinguish from a trench. As used in the present application, the "trench" refers to a structure formed in the substrate 50, while the "cavity" refers to structures formed in the isolation oxide 58 disposed within the trench. *See* Application, page 11, lines 16-20. As noted above, each of the present independent claims recites a doped polysilicon material (e.g., 64) disposed in shallow cavities (e.g., 60) *formed in an isolation oxide region* (e.g., 58).

The Michejda reference *does not* disclose *shallow cavities formed in an isolation oxide region*. In contrast to the subject matter recited in each of the independent claims of the present application, the Michejda reference discloses a semiconductor device 100 in which doped material 170 is deposited in trenches 140, 145 *formed in the semiconductor substrate*. Isolation structures 150 are formed inside the trenches 140, 145, and doped material 170 is deposited in the substrate trenches 140, 145 on top of the isolation structures 150. *See* paras. 0033-0034; *see also* Fig. 1A.

Insufficiency and Inconsistency of the Examiner's Rejections

The Examiner's rejection of claim 12 throughout the prosecution history of the present application is representative of the Examiner's persistently inconsistent, ambiguous and ultimately insufficient rejections based on the Michejda reference. Accordingly, for the sake of

brevity, Appellants will focus on the Examiner's treatment of claim 12. However, Appellants respectfully assert that similar inconsistencies, ambiguities and insufficiencies can by identified with respect to the rejections of independent claims 17 and 22, as well.

In the first Office Action mailed February 14, 2005, and with specific reference to claim 12, the Examiner stated:

> Regarding claim 12, Michejda et al. discloses on figure 1A a transistor comprising a drain terminal 178 comprising a doped polysilicon material (para [0049]) disposed within a first shallow cavity formed in an isolation oxide region; a source terminal 178 comprising a polysilicon material (para [0049]) disposed within a second shallow cavity formed in the isolation oxide region; a channel 130 formed in a silicon material and arranged between each of the first shallow cavity and the second shallow cavity, wherein the channel comprises a respective doped region (para [0041]) coupled to each of the drain terminal and the source terminal; and a gate 120 disposed over the channel and comprising one conductive layer disposed over a gate oxide layer 122.

Thus, in the initial rejection of claim 12, based on Michejda, the Examiner failed to specifically identify what was being correlated with the recited "isolation oxide region" and what was being correlated with the recited "first shallow cavity formed in the isolation oxide region," and the "second shallow cavity formed in the isolation oxide region."

In response, Appellants respectfully asserted that the source and drain structures 178 of Michejeda are formed within trenches 410 and 415, which are formed in the semiconductor substrate 110/210. At best, these trenches 410 and 415 would be analogous to the trenches 52 shown in Fig. 3 of the present application. The polysilicon material disposed to form the source and drain structures 178 of the Michejda reference are disposed in the trenches formed in the semiconductor substrate 110/210. However, the Michejda reference does not disclose a drain terminal and a source terminal disposed within shallow cavities which are *formed in an isolation oxide region*, as recited in claim 12. In fact, the Michejda reference does not disclose forming

shallow cavities in an isolation oxide region, at all, much less that the drain and source terminals of a transistor are formed therein.

On July 14, 2005, the Examiner issued a Final Office Action. In the Final Office Action, the Examiner provided a more specific, but still insufficient rejection. Specifically, the Examiner stated:

> Michejda et al. discloses on figure 1A a transistor comprising a drain terminal 178 comprising a doped polysilicon material (para [0034], lines 5-6 and para [0058]) disposed within a first shallow cavity formed in an isolation oxide region 150 (para [0033], line[] 4); a source terminal 178 comprising a polysilicon material disposed within a second shallow cavity formed in the isolation oxide region; a channel 130 (para [0033], line 3) formed in a silicon material and arranged between each of the first shallow cavity and the second shallow cavity, wherein the channel comprises a respective doped region (para [0042]) coupled to each of the drain terminal and the source terminal; and a gate 120 (para [0032], line 2) disposed over the channel and comprising one conductive layer disposed over a gate oxide layer 122 (para [0032], lines 4-5).

Thus, in his second (final) rejection, the Examiner analogized the isolation structures 150 in Michejda et al. with the isolation oxide region in claim 12. However, the Examiner again failed to identify shallow cavities formed in the isolation structures 150 in Michejda et al., as further recited in claim 12. In the Response to Arguments section of the Final Office Action, the Examiner again stated that "Michejda et al. clearly discloses on figure 1A a drain terminal and a source terminal 178 disposed within shallow cavities, which are formed in the isolation oxide region 150 (para [0033], lines 5-7)."

Appellants again asserted that Michejda in no way discloses cavities formed *in the isolation oxide regions as recited in claim 12.* In Michejda, doped material is disposed over the isolation structures 150 that are located within the substrate trenches. Para. 0034; *see also* Fig. 10. In sharp contrast, claim 12 requires that the doped polysilicon material be disposed *in shallow cavities that are formed in the isolation oxide regions (i.e., isolation oxide 58).* This

distinction is an important and novel element of claim 12. Clearly, there are no cavities formed in the isolation structures 150 and thus, no material can be disposed in cavities formed in the isolation structures 150.

Despite the Examiner's assertion that Michejda discloses cavities formed in the isolation oxide region, the Examiner failed to specifically identify any element of Michejda which is analogous to cavities *in the isolation oxide region*. Contrary to the Examiner's assertion that the isolation structures 150 include cavities in which doped polysilicon material is deposited, the isolation structures 150 disclosed in Michejda appear to be mound-like structures. There are simply no features in Michejda that could be reasonably construed as cavities formed in the isolation structures 150. *See* Fig. 1A.

In the subsequent Advisory Action, the Examiner directed Appellants to the structure disclosed in Fig. 8 of Michejda. Specifically, the Examiner stated: "Michejda et al. clearly discloses in figure 8 (showing the process steps of forming the structure of figure 1A) shallow cavities 410, 415 (para [0046], line 4) formed in the isolation structure 710, 810 (para [0046], line 3 and para [0047], line 3). Note that elements 410, 415 are openings formed in the isolation structure 710, 810, and therefore considered 'shallow cavities'." Thus, the Examiner appeared to be citing both the isolation structures 150/810 and the nitride spacer 165/710 as corresponding to the isolation oxide region recited in claim 12. As a preliminary matter, Appellants respectfully note that the nitride spacer 165 is a *nitride*. Nitride is clearly not an *oxide*, and therefore, cannot be an isolation oxide.

However, regardless of whether the Examiner is analogizing the isolation structures 150/810 (Fig. 1A/ Fig. 8) alone with the presently recited "isolation oxide regions" or analogizing the isolation structures 150/810 (Fig. 1A/ Fig. 8) in combination with the nitride sidewall spacers 165/710 (Fig. 1A/ Fig. 8) with the presently recited "isolation oxide regions," Michejda et al. in no way discloses cavities formed *in the isolation oxide regions* as recited in claim 12. As disclosed in the Michejda reference, trenches 410 and 415 are formed *in the*

substrate 210. *See* Fig. 4 and paragraph [0041]. After the trenches 410 and 415 are formed in the substrate 210, *nitride wall spacers 710 and isolation structures 810 are formed in the trenches 410 and 415. See* Figs. 5-8 and paragraphs [0045] – [0047]. Finally, the polysilicon 1010 is disposed over the remaining nitride wall spacers 710 and the isolation structures 810 *within the substrate trenches. See* Fig. 10 and paragraph [0049]. It is clear from the Michejda reference that the nitride wall spacers 710, isolation structures 810 and polysilicon 1010 are each disposed within the trenches 410 and 415 formed in the substrate 210.

In sharp contrast, independent claim 12 requires that the doped polysilicon material be disposed *in shallow cavities in the isolation oxide region.* This distinction is an important and novel element of each of the independent claims. In order for the Examiner to establish a *prima facie* case of anticipation or obviousness, Michejda would have to disclose shallow cavities formed in the nitride wall spacers 165/710 and/or the isolation structures 150/810. However, Michejda does not disclose such a feature. There is no cavity formed in either the spacers 165/710 or the isolation structures 150/810. The Examiner analogizes the trenches 410 and 415 with the presently recited cavities. However, the trenches 410 and 415 are *not* formed within the spacers 165/710 and/or isolation structures 150/810. Michejda teaches exactly the opposite. That is, the spacers 165/710 and isolation structures 160/810 are formed within the trenches 410 and 415. Because the trenches 410 and 415 are clearly formed *before* deposition and formation of the nitride sidewall spacers 165/710 and the isolation structures 150/810, the Examiner's position that these trenches 410 and 415 are "formed in" the sidewall spacers 165/710 and/or isolation structures 150/810 is untenable and completely contrary to the clear teachings of Michejda. There are simply no features that could be reasonably construed as cavities formed in the sidewall spacers 165/710 and/or the isolation structures 150/810.

In response to Appellants submission of the Appeal Brief, the Examiner again changed the application of structures disclosed by Michejda to the instant claims. In the Examiner's Answer, under Section (10): Response to Argument, the Examiner stated:

> Appellant argues Michejda et al. does not disclose, "cavities formed in an isolation oxide region" and cannot possibly disclose disposing "a doped polysilicon material formed within the cavities formed in the isolation oxide region' as recited in claims 12, 17 and 22. However, as shown in figures 7-18 (showing the process steps of forming the structure of figure 1A) the isolation oxide regions 810, 510 are clearly disposed within the trenches 410, 415 (para [0046], lines 1-8). Hence, the doped polysilicon materials 1010 are formed in the isolation oxide regions 810, 510 within the trenches 410, 415. Therefore, based on the definition of "cavity" of the present application, Michejda et al. discloses the doped polysilicon material is disposed within the shallow cavity formed in an isolation oxide region.

Thus, the Examiner now includes citation of the pad oxide 160/510 in correlating elements of the Michejda reference with the recited isolation oxide region. Appellants assert that those skilled in the art would not associate a pad oxide, such as the pad oxide 160/510 of Michejda, with an isolation oxide region, such as the isolation oxide region 58 of the instant claims. Further, the pad oxide 160/510 does not meet the remaining limitations of the claim. For instance, if the Examiner chooses to correlate the pad oxide 160/510 with the recited isolation oxide region, Appellants respectfully submit that the Michejda reference does not further disclose that a doped polysilicon material is disposed in a cavity formed in the pad oxide 160/510. Therefore, the Examiner's correlation of the pad oxide 160/510 with the recited isolation oxide region is again insufficient to support a *prima facie* case of anticipation of obviousness with respect to the present claims.

In summary, throughout the Examiner continued to alter his application of various elements and inconsistently apply those element of the Michejda reference in support of his rejections. However, none of the Examiner's citations in Michejda is sufficient to support a *prima facie* case of anticipation or obviousness, because the Michejda reference does not disclose each and every feature of the present claims. In the first Office Action, the Examiner

failed to make any specific correlation between elements shown or taught in Michejda with the recited "isolation oxide region" and the first and second shallow "cavity formed in the isolation oxide region." In the second/final Office Action, the Examiner correlated the isolation structures 150/810 with the recited "isolation oxide region," but again failed to direct Appellants to anything in Michejda that could be interpreted as first and second shallow cavities formed in the isolation structures 150/810. Indeed, there are no cavities formed in the isolation structures 150/810. Next, in the Advisory Action, the Examiner appeared to correlate both the isolation structures 150/810 and the nitride spacers 165/710 of Michejda with the recited "isolation oxide region." However, the Examiner again failed to direct Appellants to anything in Michejda that could be first and second shallow cavities formed in either the isolation structures 150/810 or the nitride spacers 165/710. Indeed, there are no cavities formed in the isolation structures 150/810 or the nitride spacers 165/710. Now, in the Examiner's Answer mailed in response to the submission of the Appeal Brief, the Examiner has included the pad oxide 160/510 of Michejda in the identification of elements correlated to the recited "isolation oxide region." However, the Examiner again failed to direct Appellants to anything in Michejda that could be first and second shallow cavities formed in the pad oxide 160/510. Indeed, Michejda does not teach "a doped polysilicon material disposed within a first [or second] shallow cavity" formed in the pad oxide 160/510.

Regardless of how the Michejda reference is applied, the Michejda reference, either alone or in combination with any of the art of record, does not disclose each of the features recited in the independent claims and therefore cannot possibly anticipate or render obvious the recited subject matter.

Conclusion

Appellants respectfully request that the Board favorably consider the above arguments in addition to the arguments set forth in the Appeal Brief, submitted on January 13, 2006. Appellants further respectfully request that the Board withdraw the outstanding rejections and pass the present application to allowance.

Respectfully submitted,

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